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Simulation of wake effects between two wind farms

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DTU Wind Energy – Fluid Mechanics



Support by



- Introduction EERA-DTOC;
- Layout of the offshore wind farm cluster;
- Participants & models;
- Identification of a flow case;
- Results from SCADA data analysis;
- Results from the cluster models;
- Comparison of park efficiency;
- Conclusion & acknowledgement;

EERA:

European Energy Research Alliance

EERA-DTOC.EU

The **DTOC** project combines expertise to develop a multidisciplinary integrated software tool for an: optimised design of offshore wind farms and clusters of wind farms.

The wake models results are compared to the measurements of wake effects:

- 1) between wind turbines and;
- 2) between wind farms;

Rødsand II wind farm

- Owner: E.ON
- SWP: 2.3-92.6m, VS & VP
- Spacing: variable 5 – 6 – 7 – 10D
- Operational status: good
- 1 month data 5-10 m/s representing East & West

Problems

- Lack of inflow reference & time stamps

Nysted wind farm

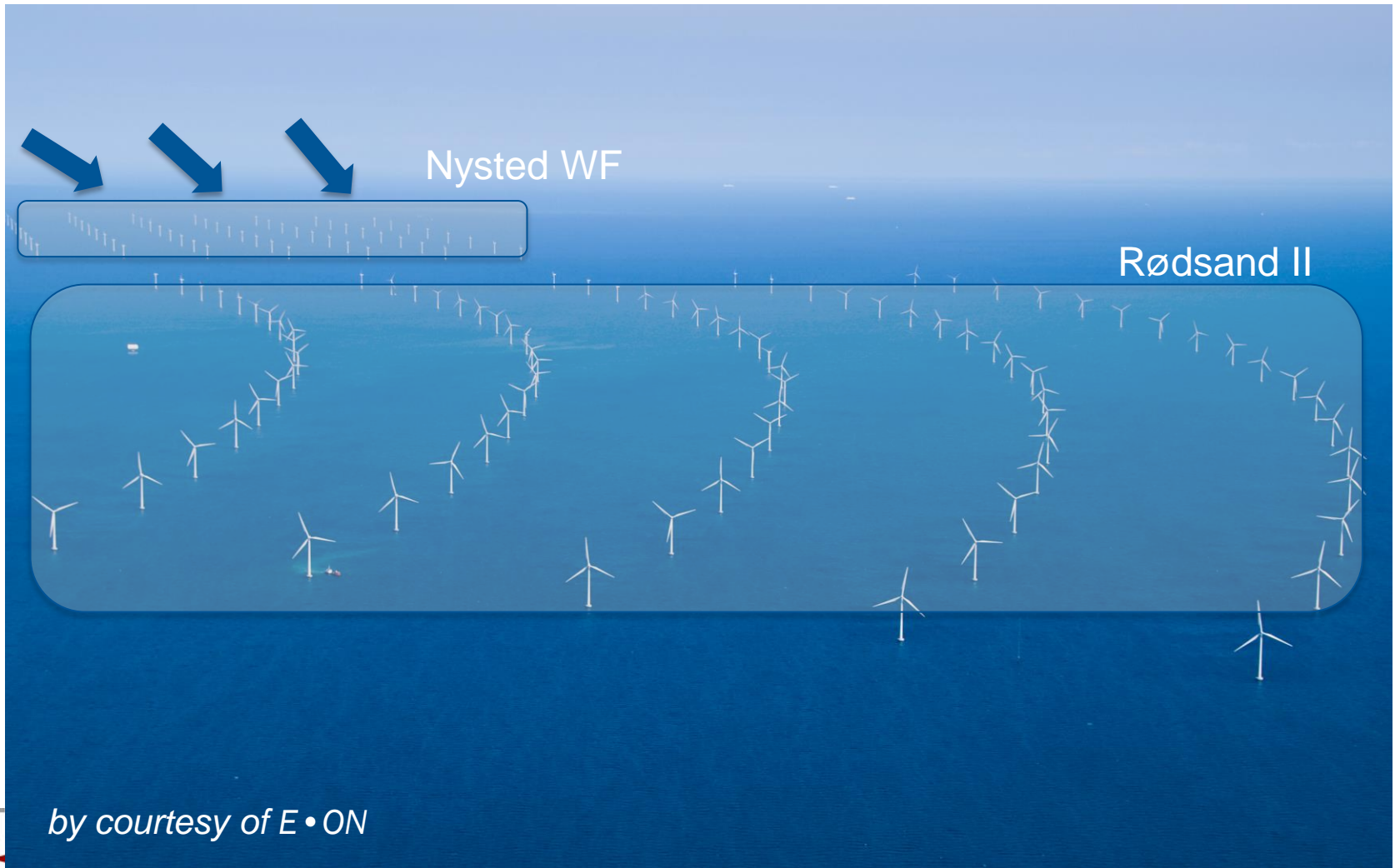
- Owner: DONG Energy A/S
- Bonus 2.3-82.4 m, 2-speed, active stall
- Principal spacing: 10.1 & 5.6 D
- Annual eq. full load hours ≈ 3300

Problems

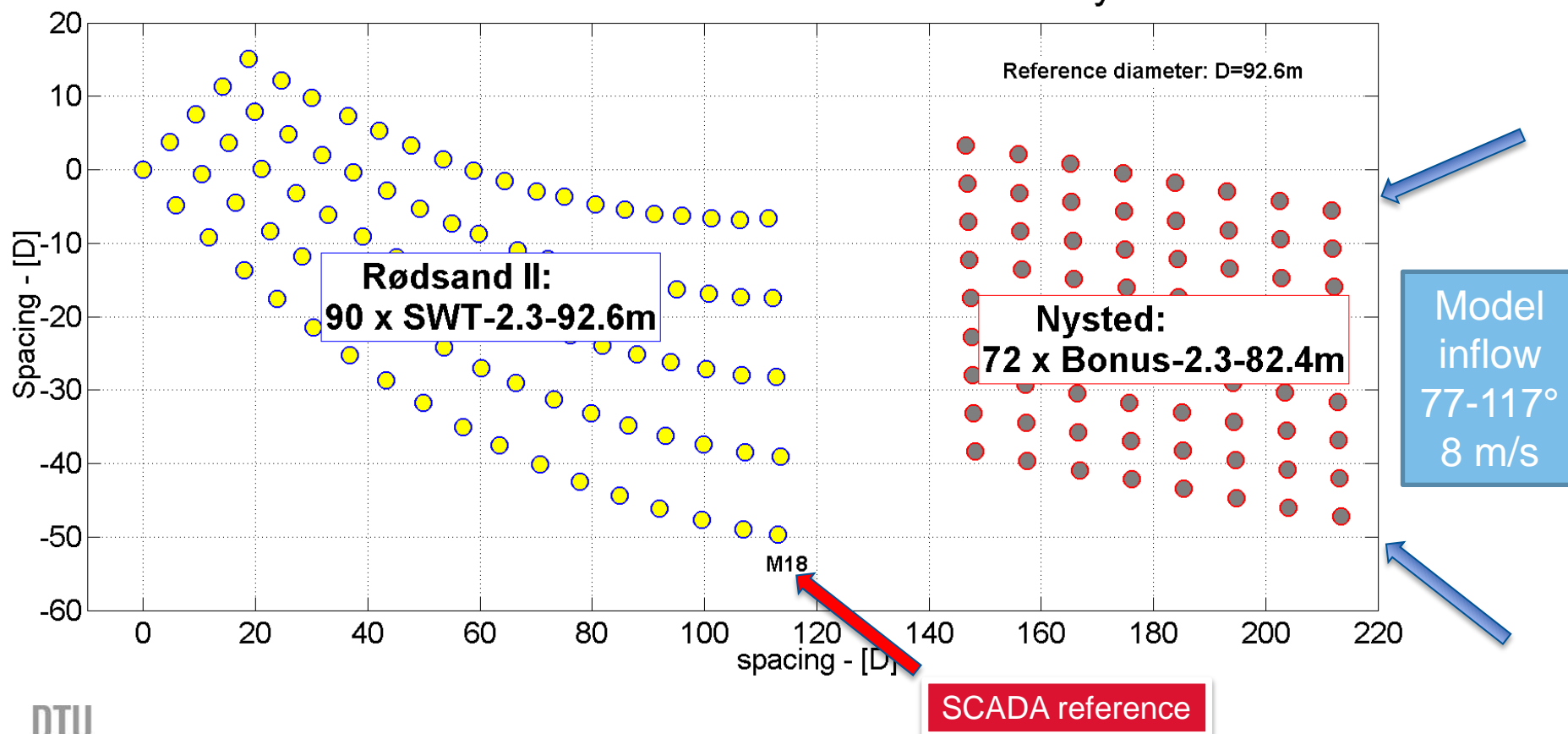
- Different owner
- Lack of synchronization ←



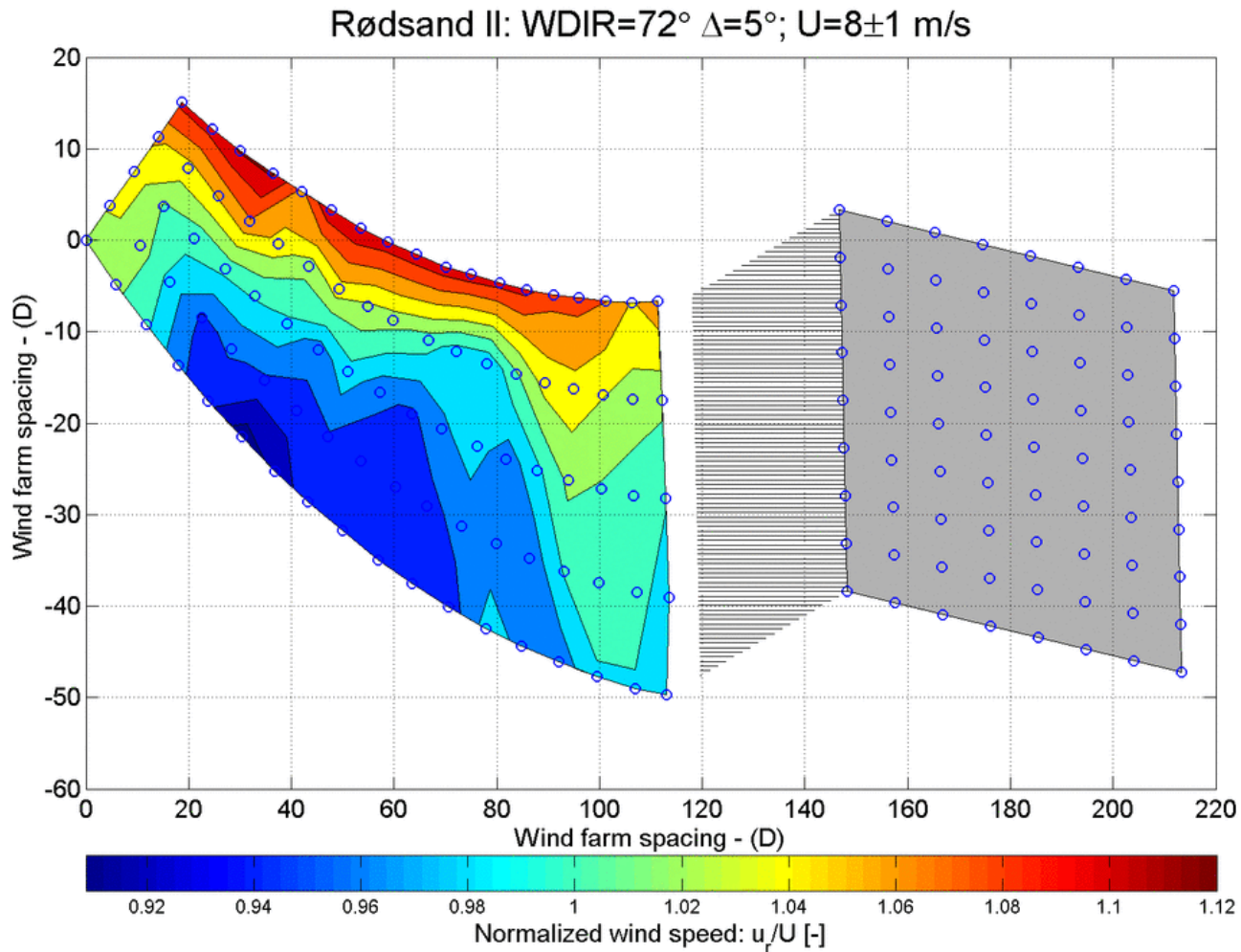
Cluster layout



Offshore wind farm cluster: Rødsand II & Nysted

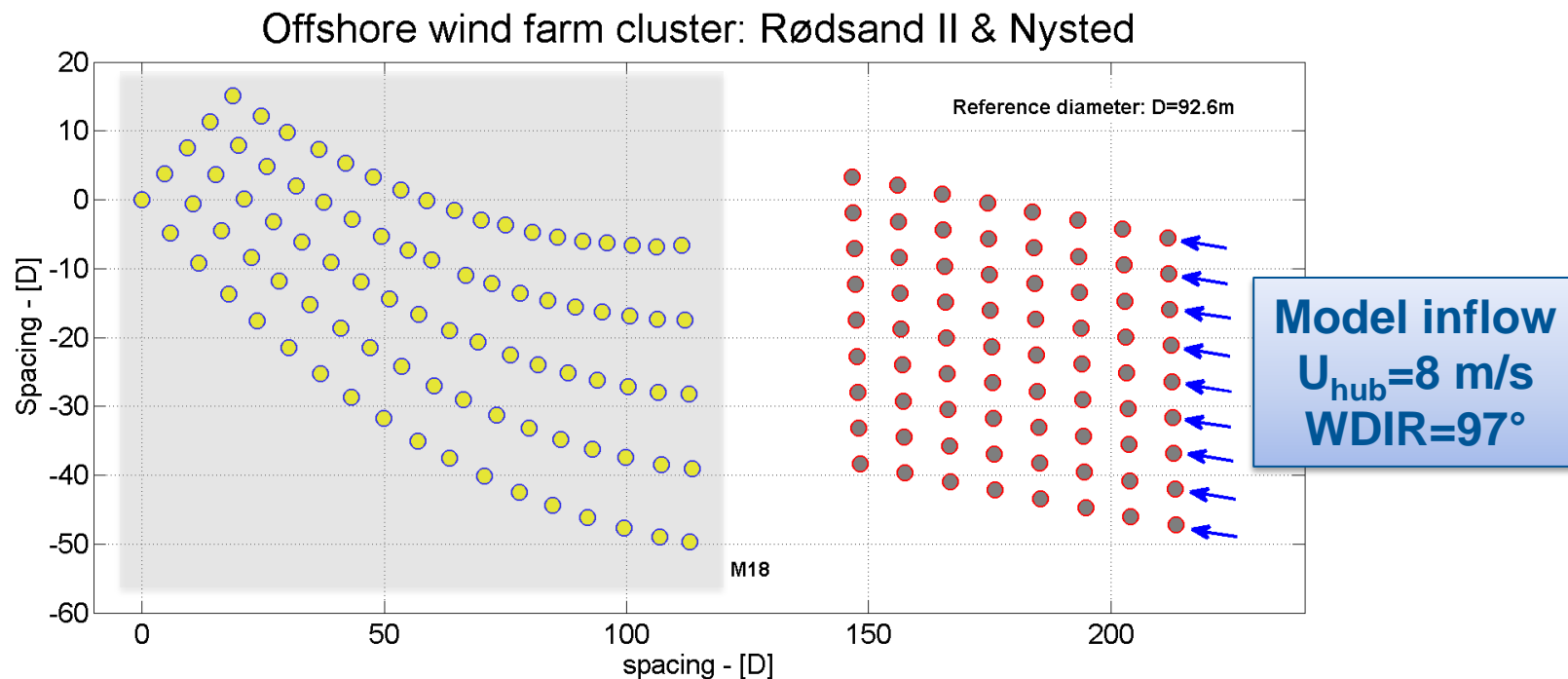


Visualisation of SCADA analysis



	Models	Affiliation
	SCADA(BA)	DTU Wind Energy/K.S.Hansen
1	FUGA/SO	DTU Wind Energy/S. Ott
2	NOJ(GU)	DTU Wind Energy/A. Pena
3	NOJ/Penã	DTU Wind Energy/A. Pena
4	WRF/UPM	Ciemat/A.Palomares
5	Meso/PV	DTU Wind Energy/P.Volker
6	AD/RANS	UPORTO/J.L. Palma
7	CFDWake	CENER/B.G. Hevia
8	CRESflowNS	CRES/ J. Prospathopoulos
9	FarmFlow	ECN Wind Energy/J.G Scheepers
10	RANS/f _p C	DTU Wind Energy/P.vd Laan

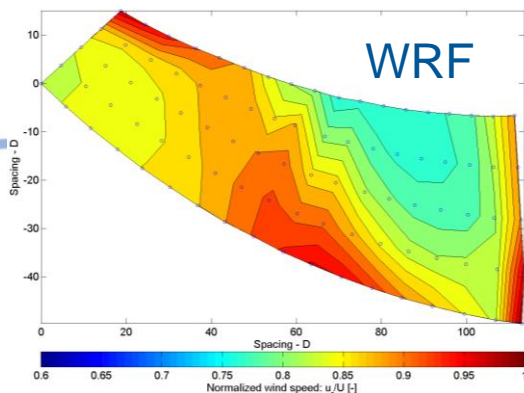
Model results for Rødsand II, $U=8$ m/s; $WD=97^\circ$



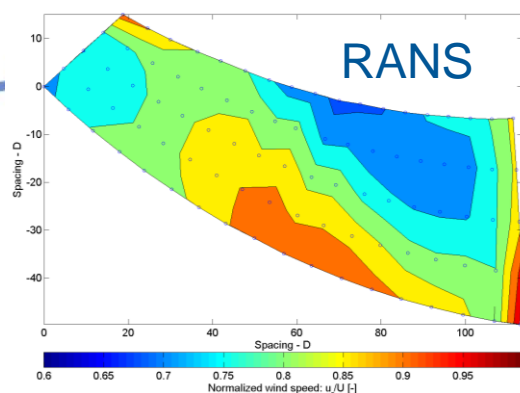
Model results for Rødsand II, $U=8$ m/s; $WD=97^\circ$



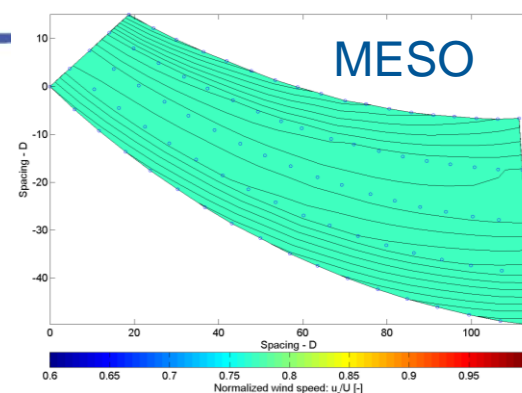
Redsand II: Sector=97.5°; $U=8$ m/s; WRF/UPM



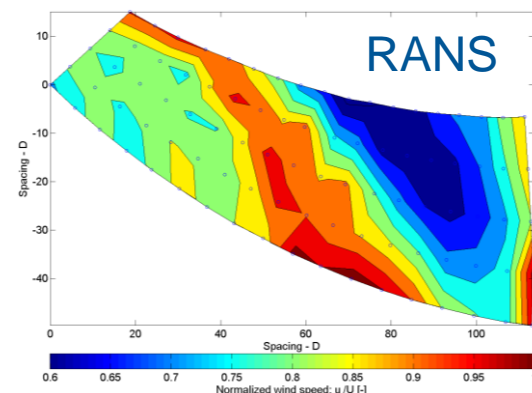
Redsand II: Sector=97.5°; $U=8$ m/s; RANS_{1,C}



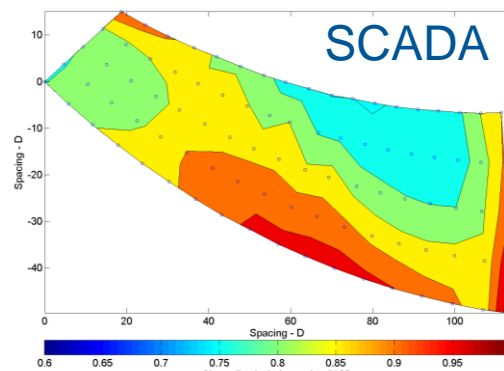
Redsand II: Sector=97.5°; $U=8$ m/s; Mesoscale



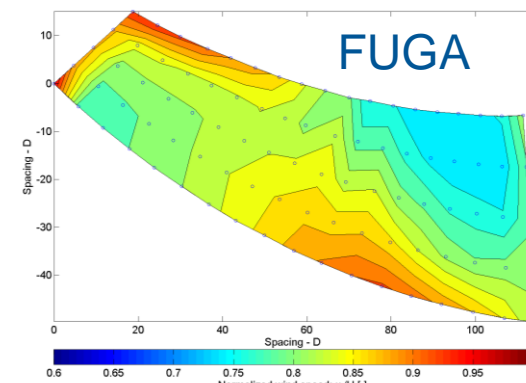
Redsand II: Sector=97.5°; $U=8$ m/s; AD/RANS



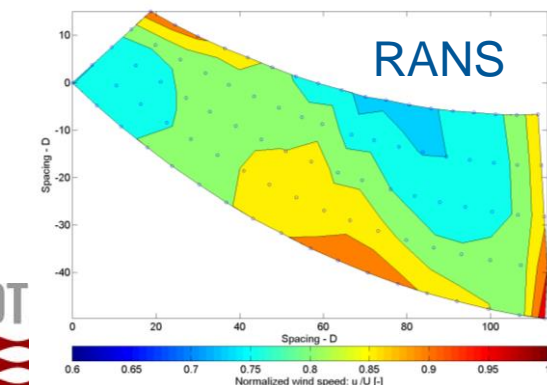
Redsand II: Sector=97.5°; $U=8$ m/s; SCADA(BA)



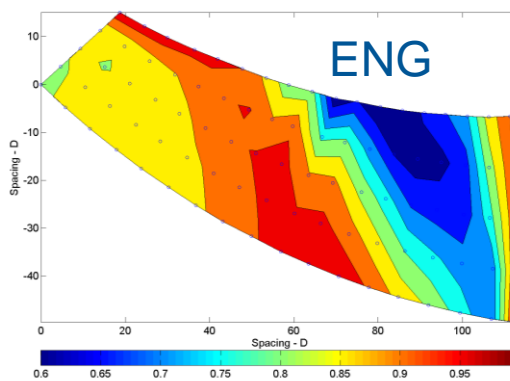
Redsand II: Sector=97.5°; $U=8$ m/s; FUGA/ISO



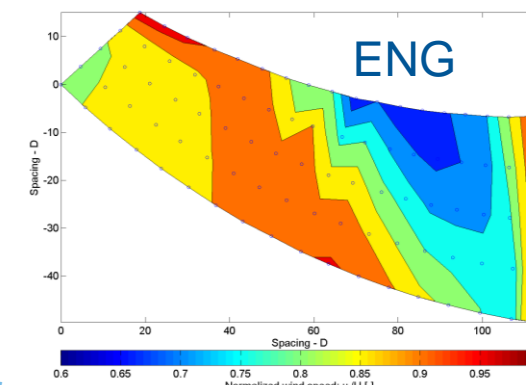
Redsand II: Sector=97.5°; $U=8$ m/s; FarmFlow



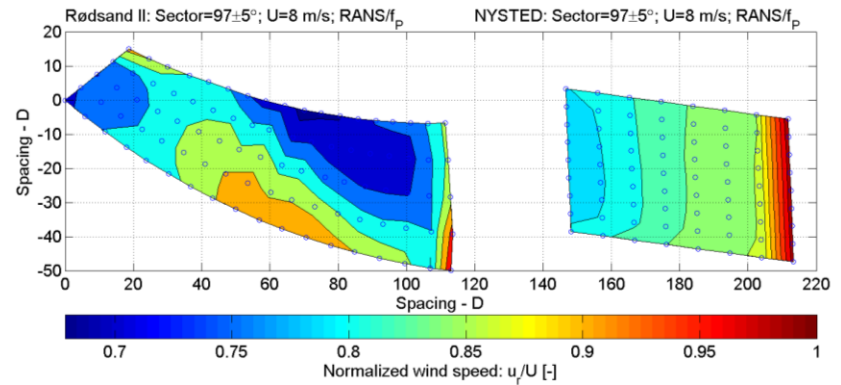
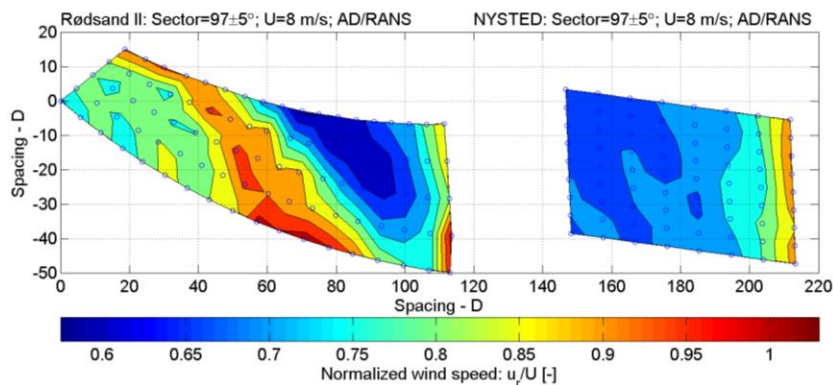
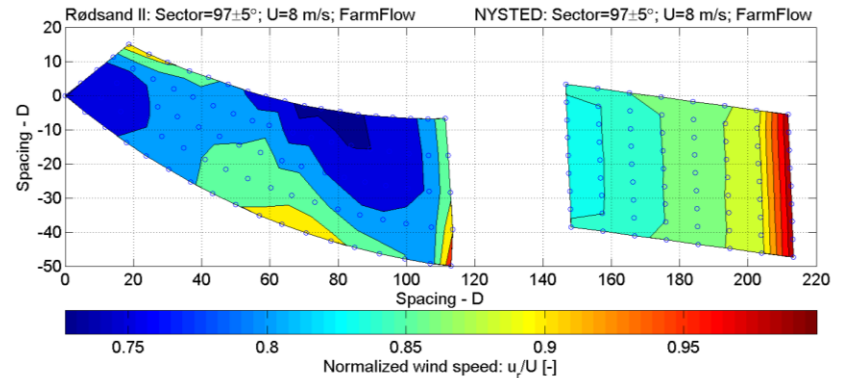
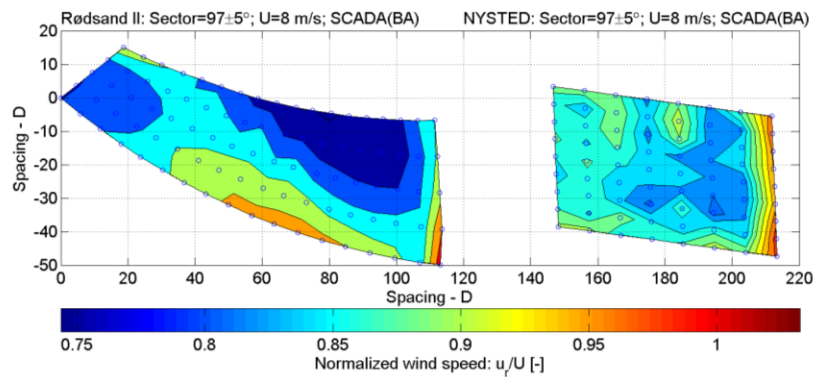
Redsand II: Sector=97.5°; $U=8$ m/s; NOJ/Penā



Redsand II: Sector=97.5°; $U=8$ m/s; NOJ(GU)

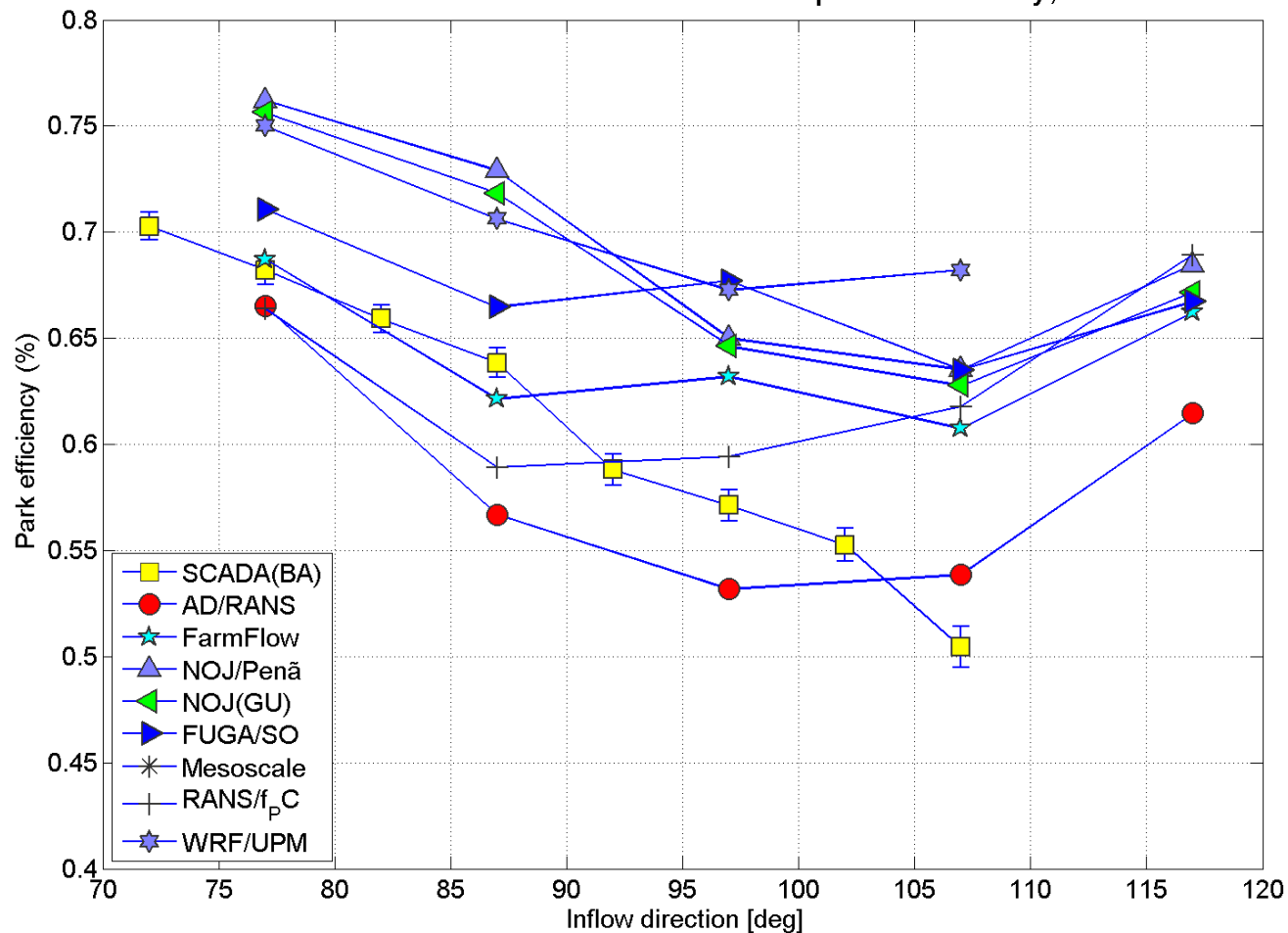


Cluster modeling results, $U=8$ m/s; $WD=97^\circ$



Park efficiency comparison

Rødsand II: Measured and simulated sectorwise park efficiency; $U=8$ m/s & $\Delta=5^\circ$



- The benchmark have demonstrated that both size and location of the distinct deficit zones - caused by the Nysted wind farm have been predicted well by the models.
- The benchmark concludes that several park models are able to handle the clustering of wind farms and ready to be integrated in the software, developed as part of “Design Tool for Offshore Wind Farm Cluster” (EERA-DTOC).

Acknowledgement

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